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Urban Planning responding to Climate Change and Strategic Environmental Assessment in Korea

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기후변화대응 도시계획과 전략환경평가

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Abstract

정부는 지구온난화로 인해 기후변화에 대응하고 세계적 경제위기를 극복하기 위해, 저탄소녹색성장기본법(2010년 1월)을 제정하여 저탄소 녹색성장을 추진하고 있다. 저탄소 녹색성장은 신재생에너지, 탄소배출권 거래제도, 5+2 광역권개발정책, 저탄소 녹색도시 등으로 요약할 수 있다.

본 연구의 목적은 저탄소 녹색도시계획 및 이에 대한 전략환경평가의 동향을 고찰하고, 저탄소 녹색도시계획에 대한 전략환경평가의 방향을 제시하는 데 있다.

저탄소 녹색도시 조성 관련 연구를 고찰한 후, 환경부의 사전환경성검토 업무매뉴얼의 도시계획의 환경성제고 방안과 국토해양부의 전략환경평가 업무처리규정, 도시계획수립지침, 저탄소 녹색도시 조성을 위한 도시계획수립지침(2009), 저탄소 녹색도시계획 표준모델(2010), 녹색도시개발계획 등을 포함하면서 개정된 도시개발업무지침(2011)이 도시계획에 제대로 반영되는지를 검토하고, 외국의 기후변화에 대응하는 전략환경평가를 고찰한 결과는 다음과 같다.

첫째, 기후변화 대응 도시계획의 내용은 저감방안과 적응방안 두 가지로 나눌 수 있는 데, 저감방안은 경제적 및 기술적으로 한계가 있으므로, 향후 전략환경평가는 저감방안과 함께 적응방안을 강조할 필요가 있다.

둘째, 기후변화 대응(저감과 적응)을 위해 전략환경평가의 목표와 지표를 설정한다.

셋째, 국토해양부의 상위계획(광역도시계획과 도시기본계획)에 대한 전략환경평가와 환경부의 하위계획(도시관리계획)에 대한 전략환경평가의 긴밀한 연계가 필수적이다.

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넷째, 전략환경평가는 도시기본계획 수립 후에 이뤄지는 독립된 과정이라기보다는 도시기본계획 수립과정에서 중요한 부분으로 인식하는 것이 중요하다. 장기적으로는 도시기본계획과 도시환경계획을 연계시키는 것이 바람직하다.

주요어 : Climate Change, Low Carbon Green City, Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), Prior Environmental Review System (PERS), Urban Planning

I. Introduction

The Korean government has come up with strategies and frameworks for low carbon green growth in order to overcome the global economic crisis and climate change. The responses to climate change are mitigation and adaptation. In Korea, the keywords on climate change mitigation are low carbon green growth. In 2010, Framework Act on Low Carbon, Green Growth was enacted, identifying policy directions as well as solidifying the institutional foundation for green growth. The main issues of low carbon green growth could be summarized as new and renewable energy, carbon emissions trading system, 5+2 Economic Region Policy and low carbon green city.

The Ministry of Land, Transport and Maritime Affairs is implementing the low carbon green city, and local governments are also establishing their basic urban planning for low carbon green city. The Presidential Commission on Green Growth established in Feb. 2009, has undergone EcoRich City whose main contents are green energy, green commuting, green oasis, green recycle, green industry, green corridor, and green humanism. Therefore the role of Strategic Environmental Assessment (SEA) on the urban planning for the low carbon green city responding to climate change has become more important than ever before.

In Korea, SEA is implemented either through Prior Environmental Review System (PERS) by the Ministry of Environment, or through SEA based on Official Order for SEA by the Ministry of Land, Transport and Maritime Affairs. Metropolitan Urban Planning and Basic Urban Planning are not the subject of PERS but that of SEA based on the official order. SEA has not yet substantially been applied to Basic Urban Planning, because the present SEA system through PERS is mainly focused on consultation function and the feedback of the planning and assessment cannot be fully undertaken.

The purpose of this study is to suggest the direction of SEA on urban planning for the low carbon green city. Many cases of low carbon green city and EcoRich City will be reviewed, and then will be reviewed the environmental improvement aspects in urban planning which are suggested in the Manual on PERS, Official Order for SEA, and various guidelines such as Guideline on Metropolitan Urban Planning, Guideline on Basic Urban Planning, Guideline on Urban Management Planning, Guideline on Urban Planning for Low Carbon Green City and Standard Model for Low Carbon Green City. Finally, the improvement of SEA on the urban planning responding to climate change will be suggested.

II. Green City in Korea

Climate change and global economic crisis

have brought about low carbon green growth policy in Korea. At the 60th anniversary of the founding of the Republic of Korea on 15 August 2008, the policy was proclaimed as Korea's new national vision. The policy pursues the paradigm shift from the current quantity-oriented and fossil-fuel dependent growth to quality oriented growth with more emphasis on the use of new and renewable energy sources.

In 2009, the Korean government released the National Strategy for Green Growth and Five-Year Plan. Now are implemented both adaptation measures and mitigation measures such as setting its goal at 30% reduction in greenhouse gases relative to BAU by 2020, and introduction of the Carbon Emission Trading Scheme in 2015. The policy is comprised of new and renewable energy, carbon emissions trading system, 5+2 Economic Region Policy and low carbon green city and EcoRich City (Figure 1).

Under the vision to be the world's 7th Green Power by 2020 and the 5th Green Power by 2050, three objectives of green growth are mitigation of climate change and energy independence; creation of new engines for economic growth; and improvement in quality of life and enhancement of international standing.

In 1990's, the keywords of urban planning could be summarized as Green City, Eco-City, Eco-Polis, and Sustainable City. After Summer 2008, those of urban planning have changed to Climate Change Adaptation City, Carbon Zero City, Carbon Neutral City, Green Growth City and Low Carbon Green City (Oh, Yongjun; Lee, Seongil; Byun, Byungseol; Lee, Jaejun; Hong, Gyounggyu, 2009, 7).

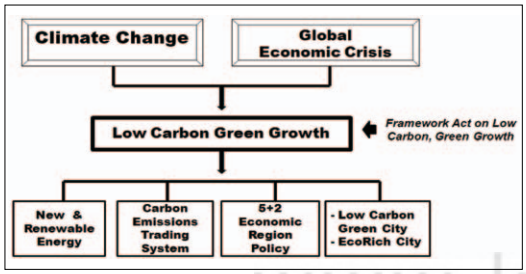

Figure 1. Background of Low Carbon Green City and EcoRich City

The direction for green city can be summarized as follows. First, the urban planning for energy saving includes minimization of travel demand for CBD through compact city; and mass transit through development of multiple transit transfer center and intelligent transportation system (ITS). Second, the city operates resource recycling facilities such as automatic collection facility of solid wastes etc.; and develops the multi-energy management system of energy, and water and rainwater management system. Third, the ecological city has waterfront space through ecological restoration of stream or river; and expands green space by provision of inner-city park and restoration of damaged green belt (Ministry of Land, Transport and Maritime Affairs, http://www.mltm.go.kr).

According to Guideline on Urban Development (2011), the planning factors of low carbon green city are land use, transportation, Eco-Building, new and renewable energy, resource recycling and park and open space, green belt etc. (Table 1). Table 2 summarizes various cases of green city planning now undertaken in Korea. The main planning factors are new and renewable energy, reduction of greenhouse gas emission, green building, and green transportation such as mass transit and bicycle etc.

The Korean government has implemented various award systems for Green City (by Ministry of Environment, 2004), Eco-City (by Ministry of

Table 1. Criteria for Assessing Green City

	Categories	Assessing Items
Carbon Absorption	park/green space	ratio of park/green space
		ratio of ecological land
		ratio of natural land
Carbon Reduction	land use	working distance
	transportation	mass transit
		bicycle
		green public transit
	Eco-building	Eco-Building Certification
	energy	new and renewable energy
	resources recycle	rainwater use
		graywater use

Source: Ministry of Land, Transport and Maritime Affairs, 2011, *Guideline on Urban Development.*

Table 2. Green City in Korea

City	Area(m^2) Population	Period	Effects	Planning Factors
Gangneung	18,326,000/ 19,000	2011~2012	• Green City Exhibition Center for promotion and experience	• green plaza (11,500m^2) • green road (1.5km)
		2013	• creation of green design tour	• bicycle, Eco-friendly Car • Carbon Neutral Environmental Infrastructure • low carbon street lamp • green home • solid waste collection system • reuse of rainwater
		2016	• test bed of green technology and industry	• light-trail, green transit transfer center • new renewable energy theme park • Smart Grid • Low Carbon Business District • Eco-village • Traditional Korean Architecture Village • solid waste cogeneration • Eco-park • Green Agricultural Complex
Pyoung-tak: Sosabul	3,021,000/ 466,000	2006~2011	• ratio of new and renewable energy > 5% • solar photovoltaic	• Green Village • new and renewable energy: solar photovoltaic, solar power generation, fuel cell • green space for carbon absorption • pedestrian walkway, bike route
Welye: Songpa	6,788,000/ 115,000	~2014	• effect of new and renewable energy = 16,982 TOE/year • CO_2 decreasing effect = 41,927 TOE/year	• green transport system • new and renewable energy: solar photovoltaic, geothermal heat, waste incineration heat

Table 2. Continued

City	Area(m^2) Population	Period	Effects	Planning Factors
Hwa-seong: Dong-tan2	2,180,000/ 260,000	2008~2012	• ratio of green transportation > 20%	• green transport system such as tram • TS type rental bicycle • new and renewable energy: solar photovoltaic, solar power generation, geothermal heat • distributed rainwater management • windway
Incheon: Gumdan	18,100,000/ 230,000	2006~2011	• ratio of mass transport: bicycle = 40 : 20 • solar photovoltaic	• Energy Saving City • new and renewable energy • resource cycle • Green Transport Plan including 30 km bike route etc. • Energy Zone Plan for education and public relation
Asan	17,600,000/ 173,000	2009~2015	• ratio of decreasing energy consumption > 35 %	• Green Home Building Energy System • new and renewable energy: solar photovoltaic, geothermal heat, Fuel Cell, Bio-energy
Seoul: Ma-gok	3,363,000/ 33,200	2007~2012	• Energy Saving and Recycling City • ratio of energy independency > 60 % • ratio of new and renewable energy > 40 % • ratio of decreasing energy use > 50 % • ratio of decreasing GHG > 65 % • ratio of decreasing fossil fuel > 15 % = 46,000 TOE	• Environmental Plan related with the Han River • Eco-Transportation System • waste treatment system • new and renewable energy specialization • Energy Zero-public building
New Capital City	72,908,000/ 500,000	2005~2030	• 25% decreasing effect of CO_2 = 209,245 TC/year	• Carbon Neutral City • IT City • new and renewable energy: solar photovoltaic, solar power generation, geothermal heat, solid fuel, digestion gas(methane) using anaerobic treatment

Sources: Korea Land Corporation, 2009, "Trends and Issues of Green City," *National Land and City Brief*, 16.
Ryu, Seongryong, 2011, "Present and Issues of Green City," *Planning and Policy*, Korea Research Institute for Human Settlement, 16-23.

Environment, 2006), Climate Change Response Model City (by Ministry of Environment, 2007), EcoRich City (nominated by the Presidential Commission on Green Growth, 2009~). EcoRich City is defined as Korean style green growth city model which tries to develop green energy, green commuting, green oasis, green recycle, green industry, green corridor and green humanism in order to make full use of climate change crisis as opportunity (Table 3).

III. SEA on Green City Planning in Korea

1. SEA and EIA

In Korea, SEA is operated by two ministries.

Table 3. Seven Factors of EcoRich City

Factors	Contents
Green Energy	supplying facilities for renewable energy, consuming limit for architectural energy, green home, and passive house
Green Commuting	bicycle, bus rapid transit(BRT), railroad, transportation card, low carbon car, mass transit district
Green Oasis	urban river ecosystem, regaining flow-rate, using rainwater, waterfront, ecological ratio of water permeability
Green Recycle	using energy from waste, reduction of construction waste
Green Industry	eco-tourism, eco-town, international cooperation and export
Green Corridor	green corridor axis and ecological space, urban biodiversity, rooftop and wall greening
Green Humanism	change of life style, environmental business, private and public consultation, education and experience program of green growth

Source: Presidential Committee on Green Growth, http://www.greengrowth.go.kr

SEA on the mid or long-term master plannings are implemented through Official Order for SEA by the Ministry of Land, Transport and Maritime Affairs, and PERS by the Ministry of Environment, which consists of (1) SEA on the administrative plannings under the mid or long- term master plannings and (2) project-EIA on small development projects in the Conservation Area. The project-EIA on large scale development is implemented by the Ministry of Environment.

Table 4 shows SEA and EIA system in Korea. For the integrated EIA system, in July 2011 EIA Act has been revised to contain all articles or provisions of PERS based on Framework Act on Environmental Policy in the previous EIA Act. Under the revised EIA Act, the environmental impact of administrative plannings and small and large development projects could be evaluat-

Table 4. SEA and EIA System in Korea

Ministry	Category	Jan. 2009 ~ Jun. 2012		after July 2012		Main contents
		legislation, official order	objectives assessed	legislation, official order	objectives assessed	
Ministry of Land, Transport and Maritime Affairs	SEA	Official Order for SEA	mid or long term master plan: • National Territorial Comprehensive Plan • Provincial Comprehensive Plan • Metropolitan Urban Plan • Basic Urban Plan	Official Order for SEA	mid or long term master plan: • National Territorial Comprehensive Plan • Provincial Comprehensive Plan • Metropolitan Urban Plan • Basic Urban Plan	macro and qualitative impact
Ministry of Environment	SEA	Framework Act on Environmental Policy(PERS)	administrative plan: Urban Management Plan	EIA Act	administrative plan: Urban Management Plan	• rationality of planning • location
	project-EIA	EIA Act	large development project		large development project	mitigation measures
	project-EIA	Framework Act on Environmental Policy(PERS)	small development project in the Conservation Area		small development project in the Conservation Area	mitigation measures

ed in very closely interlinked state, and therefore SEA and project-EIA could be implemented under one system.

2. SEA and Guideline on Urban Planning for Low Carbon Green City

1) Prior Environmental Review System(PERS) and Official Order for SEA

In Korea, SEA has been implemented either through PERS or through SEA based on Official Order for SEA. Lately Basic Urban Planning contains the concept of low carbon green city to adapt to climate change. SEA can be used to assess the impact of Basic Urban Planning in terms of reducing greenhouse gas emissions, reducing vulnerability to climate change, and making best use of climate change.

Basic Urban Planning is not the subject of PERS but that of SEA. The SEA system based on Official Order for SEA has not yet substantially been applied to Basic Urban Planning. Because it is mainly focused on consultation function, the feedback of the planning and assessment cannot be fully undertaken.

According to Manual on Prior Environmental Review System, the administrative plannings to which PERS is applied, are the plannings or assignments on urban development such as Urban Management Planning, the assignment of urban development area and urban development planning, urban and housing adjustment planning and its assignment etc. The manual requires that Metropolitan Urban Planning, Basic Urban Planning and Urban Management Planning should include development of mass transit, and maximization of new and renewable energy such as solar energy, wind energy, tidal energy and small scale hydro-power energy.

Official Order for SEA defines SEA as the process to analyze macroscopically and qualitatively the impact of the mid or long-term plannings whose impacts are difficult to assess in detail, and to consider the multiple alternatives, and to decide the best alternative for sustainable national development. The mid or long-term plannings include National Territorial Comprehensive Planning, Provincial Comprehensive Planning, Capital Region Readjustment Planning, Industrial Location Supply Planning, Housing Comprehensive Planning, Metropolitan Urban Planning, and Basic Urban Planning etc. The order requires that SEA should consider the important planning factors such as policy objectives, directions and strategies, environmental aspects of method, establishment of alternatives, the efficiency of resource and energy, and the impact on global environment.

It could be concluded that PERS and the Official Order for SEA require the urban planning include environmental conservation, but they do not suggest the sufficient contents on low carbon green city.

2) Guideline on Urban Planning

Based on National Land Planning and Utilization Act, Guideline on Metropolitan Urban Planning, Guideline on Basic Urban Planning, and Guideline on Urban Management Planning are established by the Ministry of Land, Transport and Maritime Affairs(Table 5).

(1) Guideline on Metropolitan Urban Planning

The principle of this guideline could be summarized as comprehensiveness, interconnection with the higher plannings such as National Territorial Comprehensive Planning, Regional

Table 5. Urban Planning and SEA

Category	Ministry of Land, Transport and Maritime Affairs			Ministry of Environment	
	legislation, official order, guideline		plannings applied	legislation, official order	plannings, objects applied
SEA	Official Order for SEA		mid or long term master plan: • Metropolitan Urban Plan • Basic Urban Plan	• PERS based on Framework Act on Environmental Policy (until July 2012) • EIA Act (after July 2012 EIA)	administrative plan: • Urban Management Plan etc.
Guideline with the function of SEA	National Land Planning and Utilization Act	Guideline on Metropolitan Urban Planning	• Metropolitan Urban Plan		
		Guideline on Basic Urban Planning	• Basic Urban Plan		
		Guideline on Urban Management Planning	• Urban Management Plan	• Prior Environmental Review System	
〃	Guideline on Urban Planning for Low Carbon Green City		• Metropolitan Urban Plan • Basic Urban Plan • Urban Management Plan		
〃	Standard Model for Low Carbon Green City Planning		• Metropolitan Urban Plan • Basic Urban Plan • Urban Management Plan		
〃	Guideline on Urban Development		Urban Development		

Development Planning, and Capital Region Readjustment Planning, interconnection with the lower plannings such as Basic Urban Planning and County Planning, rationality, and environmental friendly features for environmentally sound and sustainable development(ESSD).

This guideline suggests that Metropolitan Urban Planning should include objectives and strategies, current situation and characteristics of Regional Planning Zone, spatial organization design, the divisional plannings such as function sharing planning and land use planning, cultural and leisure space planning, park and landscape management planning, environmental preservation planning, transportation and distribution system, metropolitan facilities planning, landscape planning, disaster prevention planning, and adjustment of greenbelt.

(2) Guideline on Basic Urban Planning

This guideline suggests that Basic Urban Planning should include the current situation and characteristics of relevant region, the objectives and indicators, spatial organization design, land use planning(demand forecasting and allocation of land), infrastructures on transportation, distribution system, information and communications, etc. CBD and housing environment, environmental conservation and management, landscape and aesthetics, park and green area, disaster prevention and safety, economic, industrial, social, and cultural development and promotion

(3) Guideline on Urban Management Planning

According to this guideline, Urban Management Planning is the mid-term planning to realize the future direction suggested by Metropolitan Urban Planning and Basic Urban Planning. It synthesizes systematically and explains physically zoning planning, infrastructure planning, urban development planning or urban renovation maintenance planning, and the district-unit planning.

The planning should include one or more among the planning factors such as land use, transportation, environment, safety, industry, information and communications, health, public welfare, security and culture.

3) Guideline on Urban Planning for Low Carbon Green City

(1) Guideline on Urban Planning for Low Carbon Green City

The guideline defines green city as the city which minimizes environmental pollution and greenhouse gas through compact urban structure, mixed land use, public transit oriented transportation system, new and renewable energy, and water/resource cycling system.

Its purpose is to determine the planning standard of Metropolitan Urban Planning, Basic Urban Planning, and Urban Management Planning to overcome resource and environmental crisis due to climate change and to construct the urban space for low carbon green growth.

The principles of urban planning for low carbon green city could be summarized as follows. First, the planning decision maker should coincide urban planning with the policy objectives for low carbon green growth and try to strengthen link between the urban planning and National Territorial Comprehensive Planning and National Basic Climate Change Response Planning or National Basic Energy Planning. Second, should be established systematically and comprehensively the urban planning sectors such as spatial organization, transportation system, environmental conservation and management, energy, park and green space in order to cope with climate change. Third, for reducing greenhouse gas and resource-saving development, should be designed the urban planning which could minimize the consumption of limited land and fossil fuel and use them efficiently. Fourth, should be established the urban planning which secures the sources of new and renewable energy such as solar power, wind power, and tidal power etc. and should be taken the measures for supply and use of new and renewable energy for energy saving. Fifth, should be established the urban planning which could reflect the geographical and socioeconomic characteristics of the region for climate change mitigation and adaptation.

Especially the guideline requires that Basic Urban Planning should cover the sectors such as land use planning, transportation system, infrastructures, CBD and housing environment, environmental conservation and management, environmentally friendly and energy saving development, conservation of air and water environment, solid waste, energy, park and green space, disaster prevention and safety, economic, industrial, social, and cultural development and promotion.

(2) Standard Model for Low Carbon Green City

Standard Model for Low Carbon Green City (by Ministry of Land, Transport and Maritime Affairs) is prepared to complement and make clear Guideline on Urban Planning for Low Carbon Green City which explains the planning scope too widely and ambiguously. This model

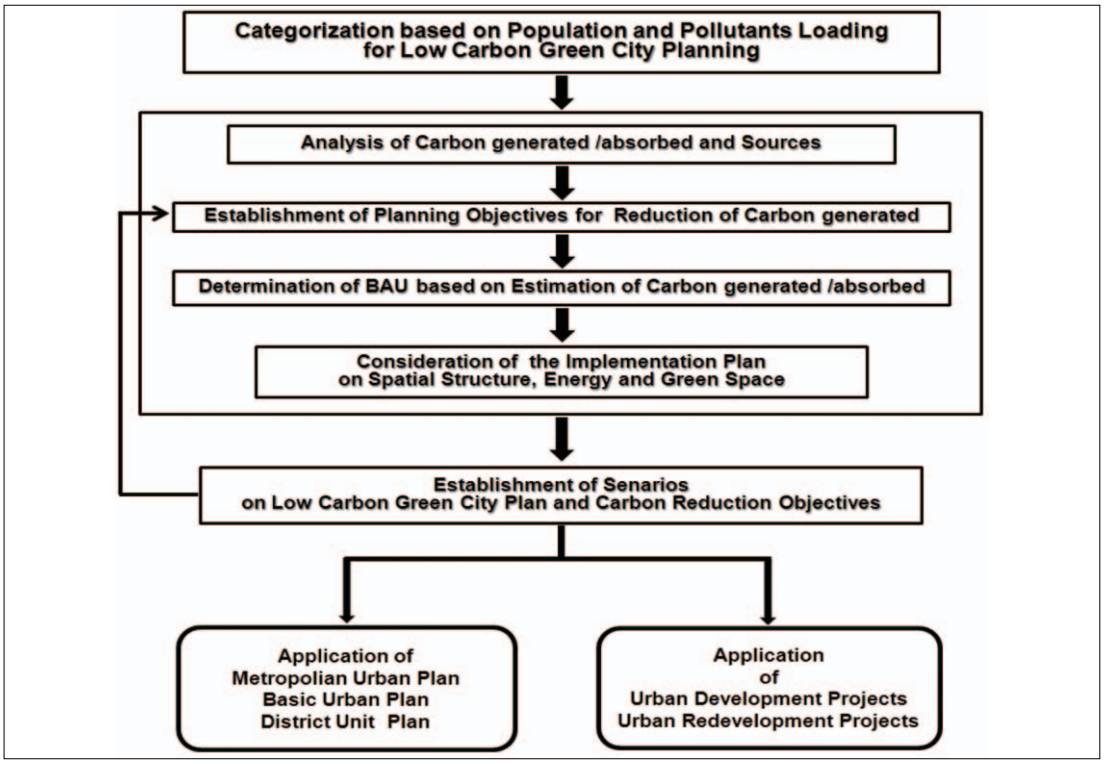

Figure 2. Planning Process of Low Carbon Green City

Source: Ministry of Land, Transport and Maritime Affairs, 2010, *Standard Model for Low Carbon Green City Planning.*

has the function to support Basic Urban Planning and Urban Management Planning. It focuses upon the urban space structure, transportation, architecture and green space. It suggests the process of low carbon green city planning: categorization of cities, analysis of carbon generated and absorbed, consideration of basic planning objectives for reduction of carbon generated, setup of BAU based on estimation of carbon generated and absorbed, and establishment of scenarios on low carbon green city and carbon reduction objectives (Figure 2).

IV. Improving SEA on Urban Planning responding to Climate Change in Korea

1. Both Low Carbon Green City and Climate Change Adaptation City

The soluting response to climate change response could be summarized as mitigation and adaptation. In the case of urban planning, the soluting response could be realized through low carbon green city mainly focused on mitigation, and/or Climate Change Adaptation City focused on adaptation (Kim, You Joung and Kim, Kyoung Bae, 2010).

In connection with urban planning, there are two SEA systems and four guidelines doing the role of SEA in Korea. Two SEA systems are

PERS and SEA based on Official Order for SEA. The four guidelines implicitly doing the role of SEA are Guideline on Urban Planning for Low Carbon Green City, Standard Model for Low Carbon Green City, Guideline on Urban Planning based on National Land Planning and Utilization Act, and Guideline on Urban Development.

But these describe mainly mitigation approach in terms of SEA on green city planning as explained before. In the SEA process on low carbon green city planning, it is important to emphasize both mitigation and adaptation to climate change.

2. Climate Change Mitigation and Adaptation in SEA Process

1) Climate Change Mitigation and Adaptation in SEA Process

There is not the comprehensive SEA manual with detailed guidelines on low carbon green city. So the SEA process in Table 6 could be applied to the SEA process on low carbon green city planning.

The left side of Table 6 shows the general SEA process, the right side does how climate change could be considered in the process. The general SEA process could be summarized as follows: First setting the context and objectives and establishing the baseline and deciding on the scope, second developing and refining alternatives and assessing effects, third preparing the environmental report, fourth consulting on the draft plan or program and the environmental report, fifth monitoring the significant effects of implementing the planning or programme on the environment.

2) Possible SEA Objectives on Climate Change

The SEA objectives on climate change mitigation include reducing the need for energy, improving energy efficiency, switching to lower carbon fuels, increasing the ratio of renewable energy, improving waste and land use practices, and maintaining carbon sequestration potential of

Table 6. Climate Change Mitigation and Adaptation in the SEA Process

SEA process	How climate change could be considered in the process
Stage A: Setting the context and objectives, establishing the baseline and deciding on the scope	• Describe the current and likely future climate baseline. • Identify the likely significant problems and constraints caused by climate change. • Identify other relevant plans which contain climate change mitigation and adaptation measures. • Develop climate change objectives and indicators. • Consult with SEA Consultation Bodies.
Stage B: Developing and refining alternatives and assessing effects	• Suggest plan alternatives (related to both mitigation and adaptation. • Assess the effects of plan alternatives on the climate change objectives and indicators. • Consider the alternatives' impacts on greenhouse gas emissions, and their ability to integrate climate change adaptation measures. • Begin to integrate climate change mitigation and adaptation measures into the plan.
Stage C: Preparing the Environmental Report	• Explain how climate change issues have been identified and managed, including how uncertainty has been managed.
Stage D: Consulting on the draft plan or program and the Environmental Report	• Consult authorities responsible for climate change management and others. • Fully integrate climate change mitigation and adaptation measures into the final plan.
Stage E: Monitoring the significant effects of implementing the plan or programme on the environment	• Monitor the effectiveness of mitigation measures in reducing greenhouse gas emissions. • Be prepared to respond to any adverse impacts identified.

Source: Environment Agency, UK, 2011, *SEA and Climate Change: Guidance for Practitioners.*

Table 7. Possible SEA Objectives on Climate Change

Category	Possible SEA Objectives
Mitigation	Minimize future climate change by • reducing the need for energy, for example reducing the need to travel • improving energy efficiency • switching to lower carbon fuels • increasing % of renewable energy • improving waste and land use practices • maintaining carbon sequestration potential of woodlands, peats and other organic soils
Adaptation	Reduce vulnerability to the impacts of climate change by • providing wildlife corridors • providing adequate health services and infrastructure • ensuring that drainage systems can cope with changing rainfall patterns/intensity • taking a precautionary and risk-based approach to developing in the floodplain • ensuring adequate sea defences • ensuring adequate future water supply and demand management • designing buildings and urban areas to cope with new climate extremes • providing robust transportation infrastructure • increasing urban green space • avoiding actions that foreclose or limit future adaptation, or contribute to climate change

Source: Environment Agency, UK, 2011, *SEA and Climate Change: Guidance for Practitioners.*

woodlands, peats and other organic soils.

The SEA objectives on climate change adaptation include providing wildlife corridors, providing adequate health services and infrastructure, ensuring that drainage systems can cope with changing rainfall patterns/intensity, taking a precautionary and risk-based approach to developing in the floodplain, ensuring adequate sea defences, ensuring adequate future water supply and demand management, designing buildings and urban areas to cope with new climate extremes, providing robust transportation infrastructure, increasing urban green space, and avoiding actions that foreclose or limit future adaptation, or contribute to climate change (Table 7).

3) Possible SEA Climate Indicators on Climate Change

The climate indicators for mitigation measures are household energy use, total electricity and gas use, vehicle-km travelled per person per year, electricity generated from renewable energy sources and Combined Heat and Power(CHP) located in the area, embodied energy in new buildings, average energy efficiency of new buildings, and the ratio of new homes conforming to recognized codes for sustainable buildings.

The climate indicators for adaptation measures are the ratio of developments with sustainable drainage systems, the number or ratio of homes in floodplain/costal flooding, the number or ratio of roads/railway lines in floodplain, the number of planning permissions granted against Environment Agency advice on grounds of flood risk, household water use, and the ratio of developments subjected to checklist for development (Table 8).

3. Integration of two Ministries' SEA on Urban Planning

There are the upper plannings to which Official Order for SEA under the Ministry of Land, Transport and Maritime Affairs are applied, and there are the lower plannings to which PERS under the Ministry of Environment are applied. SEA on Metropolitan Urban

Table 8. Climate Indicators

Aspects of Climate Change	Possible Indicators
causes	greenhouse gas emissions: per region, per capita
climate / weather changes	• sea level • precipitation • temperature • flood levels in rivers • extreme events such as heat waves
local impacts of climate / weather changes	• average annual flood incidence / damage drought orders • ranges of habitats • number of heat and/or cold related deaths • number of cases of subsidence / insurance claims for subsidence • river flows and water quality
mitigation measures	• household energy use • total electricity and gas use • vehicle-km travelled per person per year • electricity generated from renewable energy sources and Combined Heat and Power (CHP) located in the area • embodied energy in new buildings • average energy efficiency of new buildings • % of new homes conforming to recognized codes for sustainable buildings
adaptation measures	• % of developments with Sustainable Drainage Systems • number or % of homes in floodplain / costal flooding • number or % of roads/railway lines in floodplain • number of planning permissions granted against Environment Agency advice on grounds of flood risk • household water use • % of developments subjected to checklist for development

Source: Environment Agency, UK, 2011, *SEA and Climate Change: Guidance for Practitioners.*

Planning and Basic Urban Planning have been implemented through Official Order for SEA, strictly speaking, not a legislation. On the other hand, SEA on Urban Management Planning has been implemented through PERS based on Framework Act on Environmental Policy, but after July 2012, it will be implemented by Strategic Environmental Impact Assessment in the EIA Act.

Therefore, it is important to strengthen the link between SEA on upper planning and that on lower planning (Lee, Jong Ho and Cho, Jae Heon, 2007, 440-441). Furthermore, especially in order to integrate two ministries' SEA on urban planning, it could be suggested that SEA on Metropolitan Urban Planning and Basic Urban Planning, included in Official Order for SEA under the Ministry of Land, Transport and Maritime Affairs, should be transferred to EIA Act under the Ministry of Environment.

4. Integration of Development Planning and Environmental Planning

Table 9 explains the possible linkages between development plannings and environmental plannings at various planning levels such as nation level, provincial or metropolitan level, city or county level, and district level. It is necessary to coincide the planning period of development planning and that of environmental preservation planning. Then the integration of development planning and environmental preservation planning could be formally realized.

It should be emphasized that SEA is not the

Table 9. Development Plan and Environmental Plan in Korea

Planning Level	Development Plan	Environmental Plan
Nation	• National Territorial Comprehensive Plan	• Comprehensive National Environmental Plan
Province Metropolitan	• Provincial Comprehensive Territorial Plan • Metropolitan Urban Plan	• Provincial Environmental Preservation Plan • City Environmental Preservation Plan
City County	• Basic Urban Plan	• City Environmental Preservation Plan • County Environmental Preservation Plan
District	• Urban Management Plan	• District Environmental Plan

Source: National Land Planning and Utilization Act, Framework Act on Environmental Policy.
Ministry of Environment, Korea, 2006, *Guide to the Establishment of Local Government Environmental Plan*, 6.
Lee, Jong Ho and Cho, Jae Heon, 2007, "Strategic Environmental Assessment and Integration of Development and Environmental Planning in Korea," Korean Society of Environmental Impact Assessment, *Journal of Environmental Impact Assessment*, 16(6), 443.

process implemented after Basic Urban Planning but that included in the planning. It is desirable to strengthen the link between Basic Urban Planning and City Environmental Preservation Planning.

At present, the environmental management included in urban planning are not consistent with that of City Environmental Preservation Planning, therefore the two plannings seem to be operated in the separate state. If the contents and the planning periods coincide, they could be closely interlinked. And it should be emphasized the integration of urban planning and urban environmental preservation planning corresponds to SEA for sustainability (Lee, Jong Ho and Cho, Jae Heon, 2007, 443).

Ⅴ. Conclusion

This study reviewed many cases of low carbon green city and EcoRich City, the environmental improvement of urban planning included in Manual on PERS, Official Order for SEA, and various guidelines such as Guideline on Urban Planning, Guideline on Urban Planning for Low Carbon Green City and Standard Model for Low Carbon Green City by the Ministry of Land, Transport and Maritime Affairs, in order to suggest the desirable SEA methodology on urban planning for the low carbon green city.

The result of this study is as follows. First, it is necessary to emphasize both mitigation and adaptation to climate change in the SEA process on low carbon green city planning. Second, the SEA objectives and indicators on climate change should be established. Third, It is important to strengthen the links between SEA on the upper planning and that on the lower planning. In the long term, in order to integrate two ministries' SEA on urban planning, it could be suggested that SEA on Metropolitan Urban Planning and Basic Urban Planning, based on Official Order for SEA, should be transferred to EIA Act. Fourth, It should be emphasized that SEA is not the process implemented after Basic Urban Planning, but the process included in the urban planning. It is desirable to strengthen the link between Basic Urban Planning and City Environmental Preservation Planning.

Mitigating against and adapting to climate change, especially the low carbon green city should be considered at various stages of the SEA process on Basic Urban Planning to prevent, reduce and offset any significant adverse effects

on climatic factors.

Finally, it should be emphasized the integration of urban planning and city environmental preservation planning corresponds to SEA for sustainability.

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최종원고채택 11. 12. 15